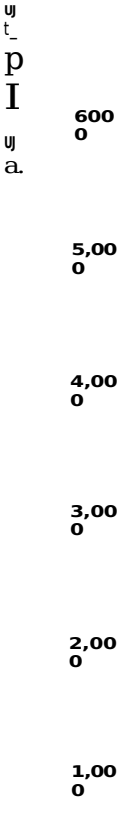
steam turbines were coupled to electrical generators. Up to that period electrical designers had been handicapped in the effective utilization of their materials by the comparatively low speeds demanded by reciprocating engines, and welcomed the advent of the steam turbine as a satisfactory means of overcoming this obstacle, although economical turbine speeds were far higher than those previously arrived at in electrical practice. In point of fact, the difficulties encountered in building direct-current turbo-generators proved



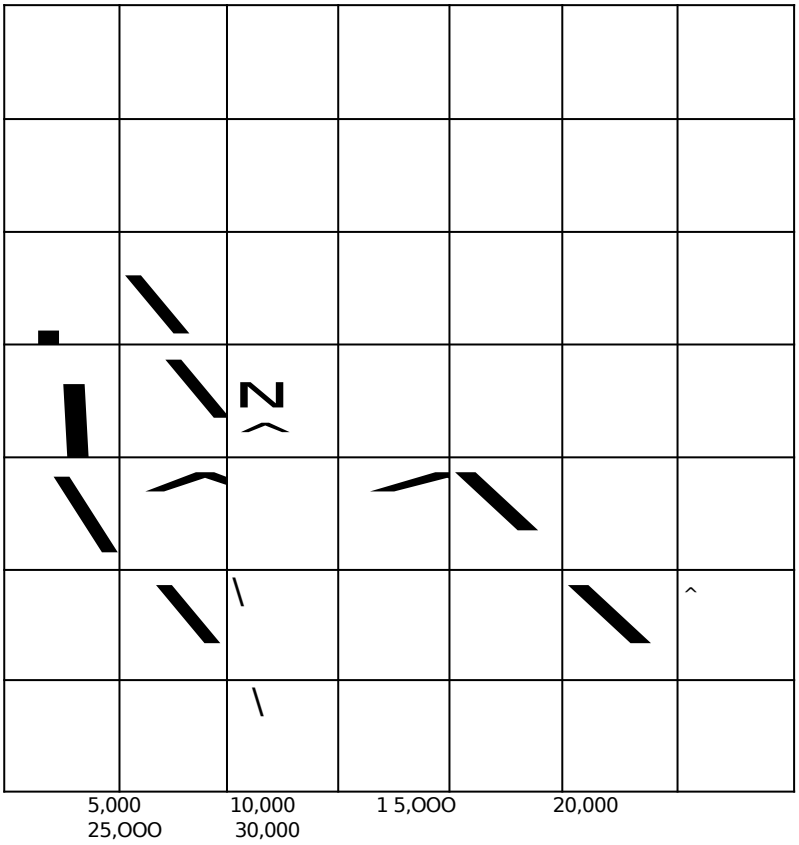


Fig. ro.—Maximum Speed Output Curves, 1913 and 1922

to be to all intents and purposes insurmountable in all but small sizes, and it was not until high-power turbine gearing was perfected that the success of direct-current turbine units was established.

On the other hand, the designers of alternators have succeeded in evolving a type of machine which differs radically in its mechanical characteristics from those adopted for low-speed designs, and which has enabled them to keep pace with turbine designers in their progress as defined by the speed output curve, except for the limitation imposed by the frequency.

There can be little doubt that the development of the steam-turbine-